National Team System Engineering Overview

8 June 2004

CAPT P. M. GRANT III
System Engineering & Integration
Missile Defense Agency

MDA SYSTEM ENGINEERING CHALLENGE

Pre-Decisional / Working Papers

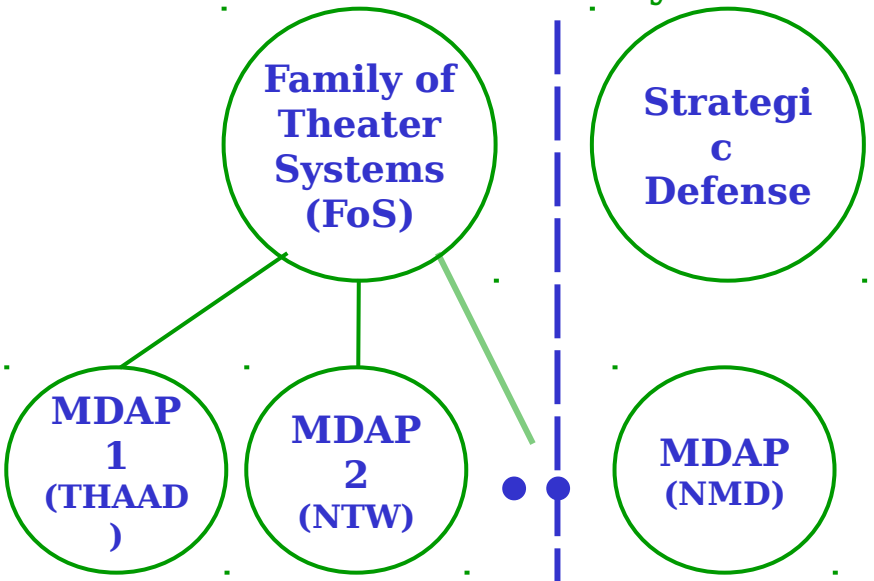
- **Near-Term Deployment – Initial Defensive Operations**
- **Engineering Challenge Dictates Use of Unified National Team**
  - **Open Consideration of All Solutions**
  - **Synergy of Distributed Sensors and Weapons**
  - **Element Alignment with BMDS Goals**
  - **Layered System**
  - **Network Centric Battle Management**

Ballistic Missile Defense on Alert, All Phases, All Ranges, All Regions

EVOLVED MISSILE DEFENSE PROGRAM

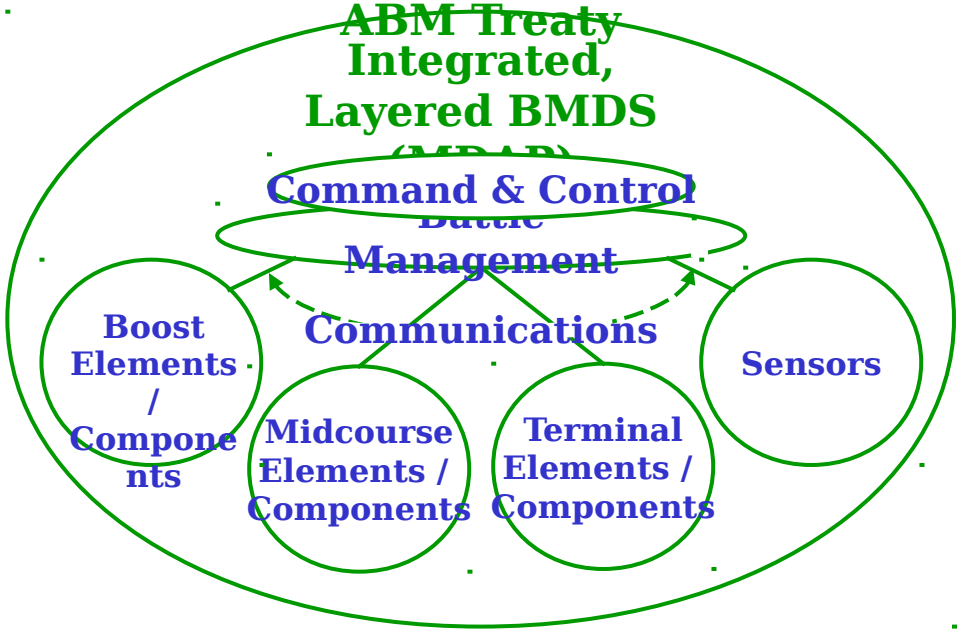
Pre-Decisional / Working Papers

Requirements-Based Acquisition Under ABM Treaty



- Each MDAP Optimized to Own ORD
  - FoS Secondary
- Aggregate FoS Performance
  - Synergistic, Limited Interoperability
- Each MDAP "Massive" Momentum, Culture,

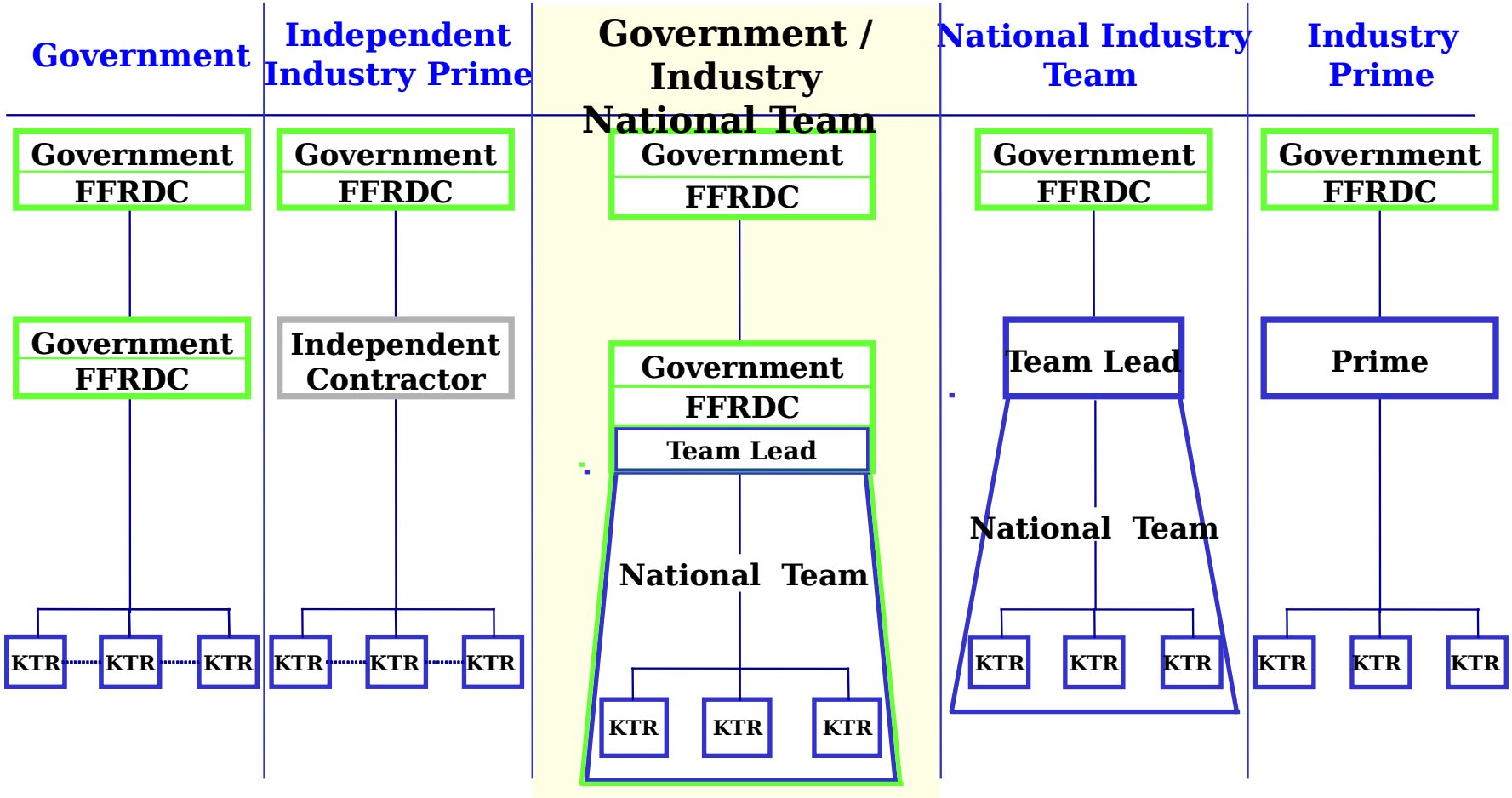
Capability-Based Acquisition After ABM Treaty



- Top-Down SE&I to "Component" Level
  - Optimize BMD System Performance
  - Disciplined, Quick, Flexible Change Management
- Annual Procurement and Fielding Decisions to Desired

NATIONAL TEAM MANAGEMENT MODEL OPTIONS

Pre-Decisional / Working Papers



BMDS Requires Unified Government / Industry National Team

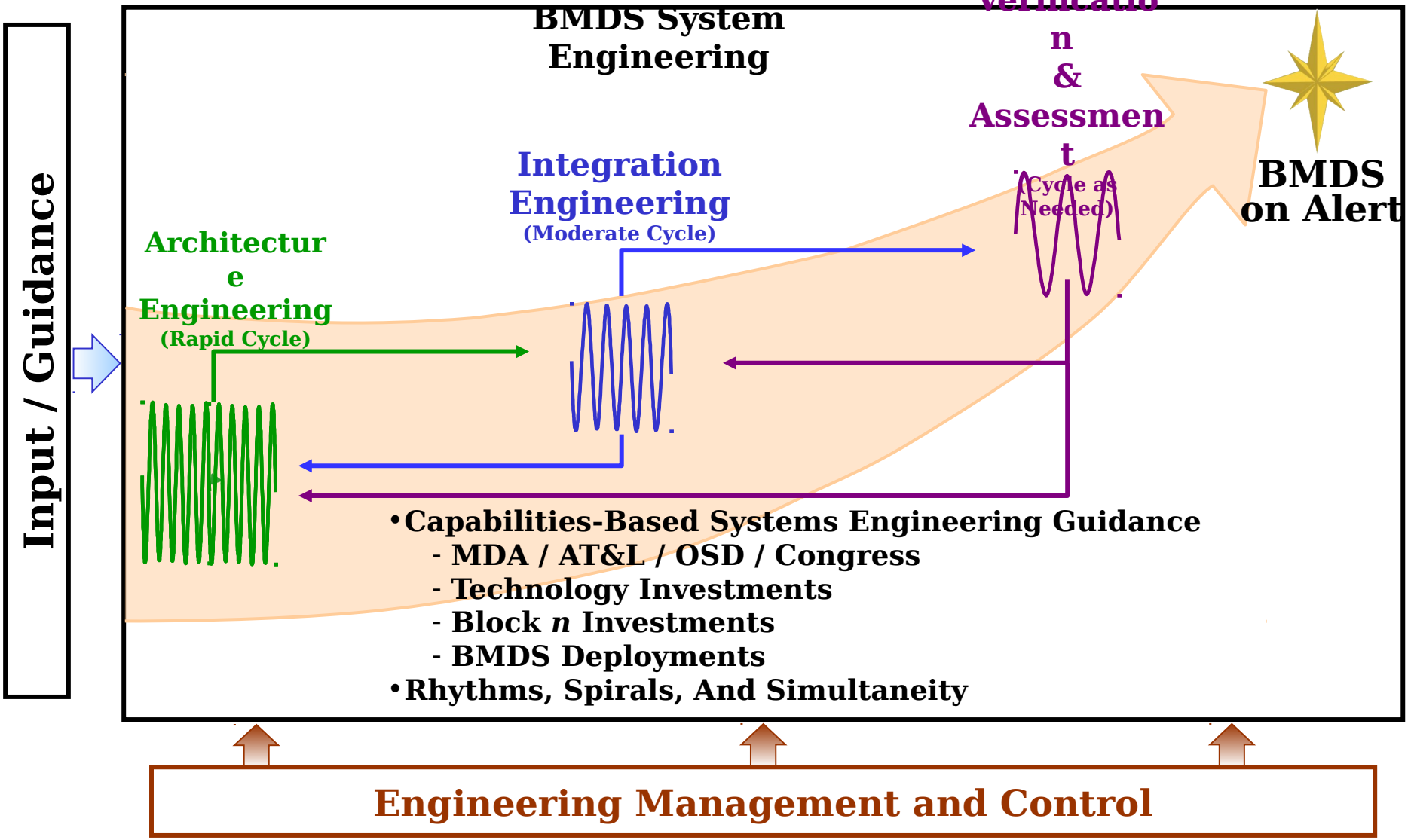
ALIGNED MISSILE DEFENSE NATIONAL TEAM GUIDANCE

Pre-Decisional / Working Papers

- **National Team Focus – High Performance and Engineering Excellence**
- **National Team Commitment – Examine the Total Spectrum of Engineering Solutions**
- **Responsible and Accountable for Design and Integration of Defense System on Alert for Ballistic Missiles in *All Phases* of Flight that Grows to Protect *All Regions* from *All Ranges***
- **Government, SETA, FFRDC and Industry Committed to Provide "Best and Brightest" Team; Aligned into a Collaborative Work Environment; Organized by Functional Working Groups**
- **Leadership of Functional Working Groups Selected from Across National Team Based on Leadership and Knowledge**
- **MDNTS has Total System Performance Responsibility**

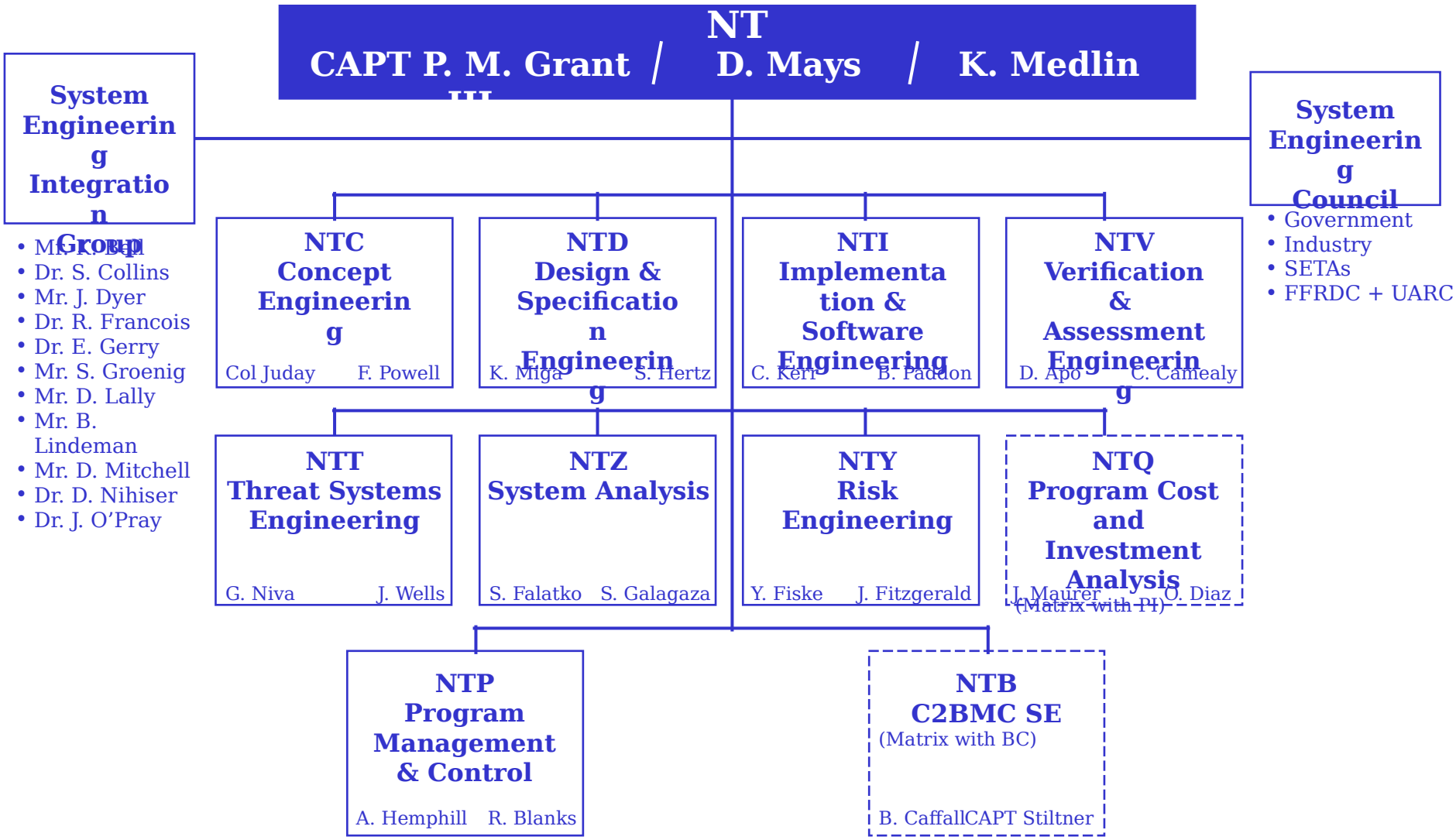
"MULTI-SPIRAL" BMDS SYSTEM ENGINEERING PROCESS

Pre-Decisional / Working Papers



NATIONAL TEAM (NT) FUNCTIONAL GROUPS

Pre-Decisional / Working Papers



MDA SYSTEM ENGINEERING

Pre-Decisional / Working Papers

Concept Engineering (NTC)
- Expand and Update the BMDS Technical Objectives and Goals (TOG) Based on Alternative Future Architecture Studies
- Develop System Evolution Plan
- Develop Block Data Packages Containing Threat Definition, System Architecture, Sub-System Descriptions, Possible Engagement Sequence Groups (ESGs), and Predicted System Performance

Design Engineering (NTD)
- Develop System Capability Specification (SCS)
- Develop Block Interface Control Specifications (ICS)

Implementation and Software Engineering (NTI)
- Provide Block System Integration Strategy, Plan, and Planning Allocation Matrix
- Configuration Control through Strict Adherence to Configuration Control Board Procedures
- Provide the Software Acquisition Program Plan (SWAP) and the Software Readiness Levels (SWRLs)

Verification and Assessment Engineering (NTV)
- Provide Block Capability Verification and Assessment Plan and Report, Test Objectives, and Target Requirements

Enabling Engineering
- Update Adversary Capability Document (ACD) (NTT)
- BMD System Risk Management (NTY)
- System Analysis for All System Engineering Functions (NTZ)

BMDS CORNERSTONES

Pre-Decisional / Working Papers

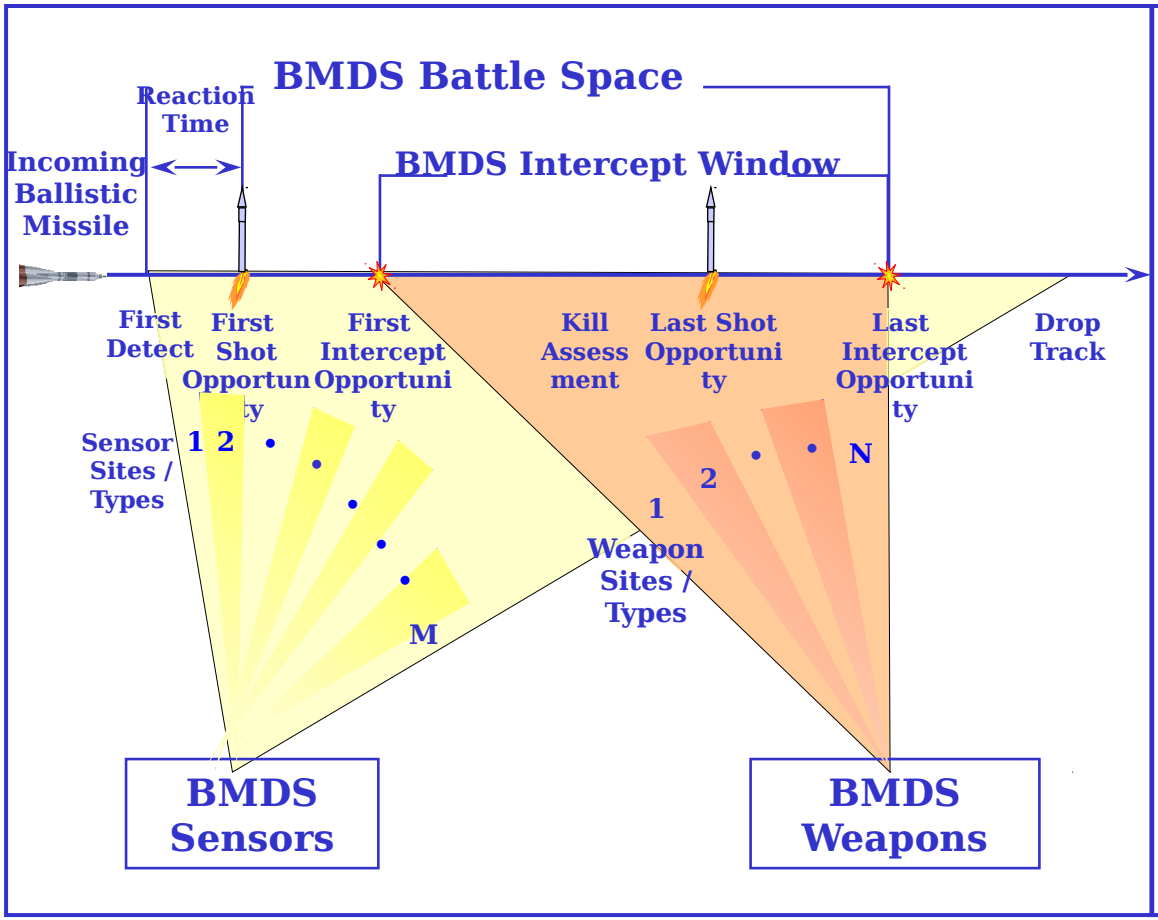
- **Reaction Time**
  - First Detect to First Missile Movement
- **Raid Size Capacity**
  - Number of Threats Destroyed
- **Availability and Reliability**
  - Continuous Availability
- **Area Defended / Area Denied**
  - Defended Area
  - TBMD Launch Area Denied
- **Countermeasures & Environmental Resistance**

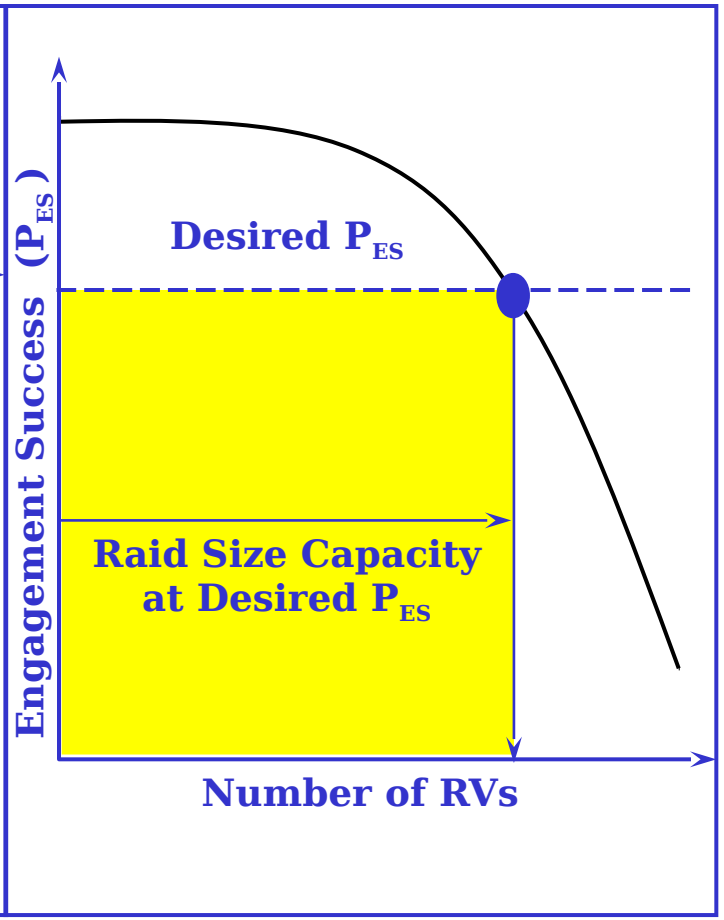
Battle Space is Driven by the Cornerstones

BMDS ENGAGEMENT CHARACTERIZATION

Pre-Decisional / Working Papers

- **BMDS Battle Space, Intercept Window, Reaction Time, and Raid S**

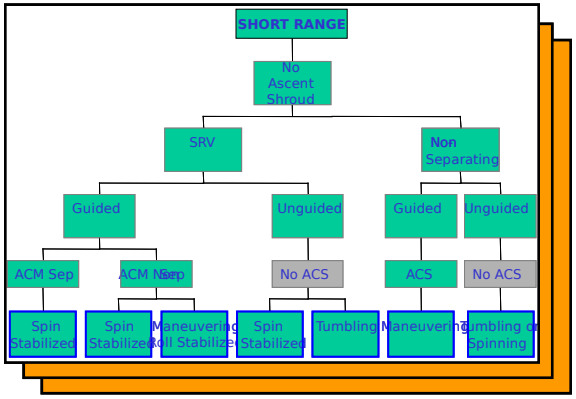




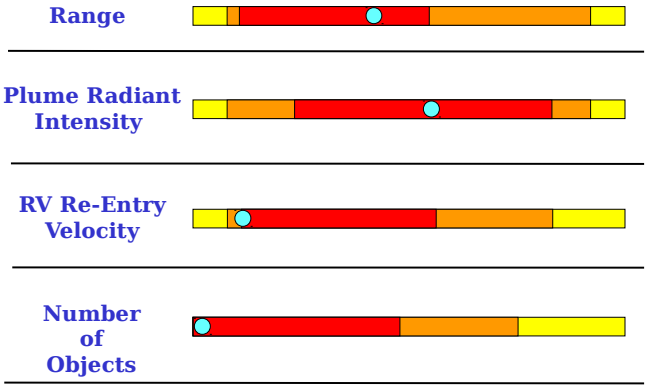
ADVERSARY CHARACTERIZATION

Pre-Decisional / Working Papers

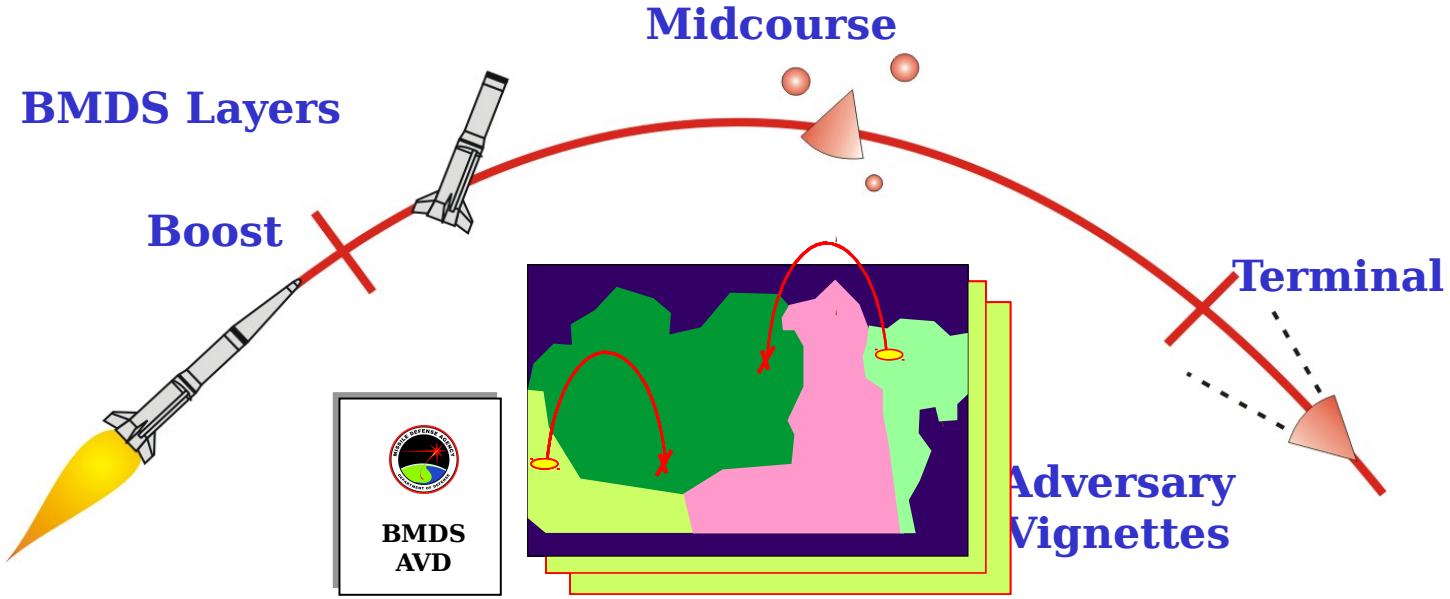
Threat Missile Taxonomy



Parametric Adversary Capability



BMDS Layers



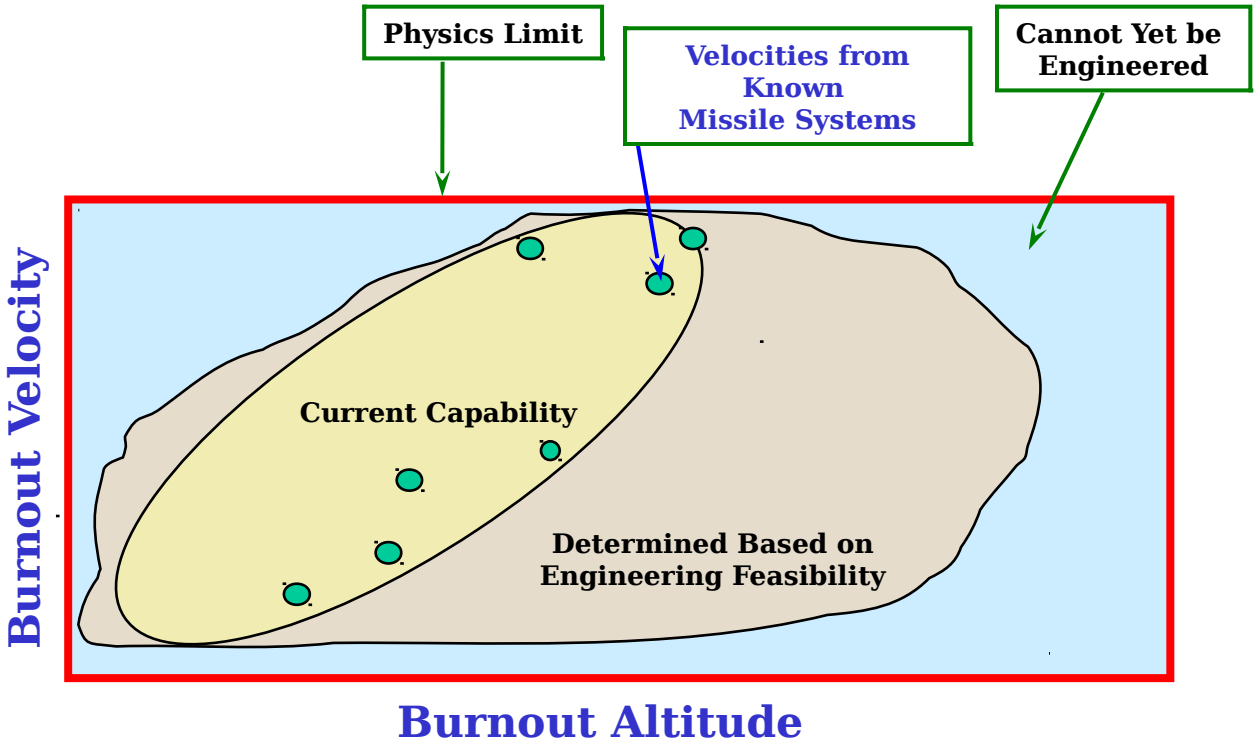
Adversary Capabilities

BMDS ACD

BOOST PHASE ADVERSARY CAPABILITY EXAMPLE

Pre-Decisional / Working Papers

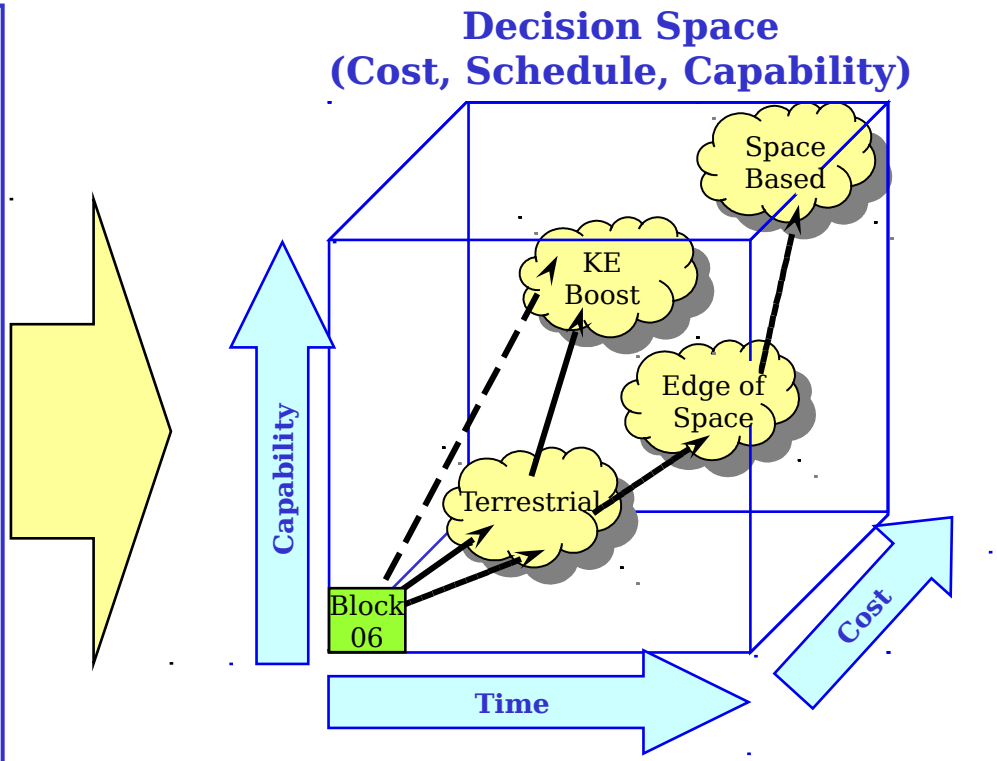
Parameter – Physics-Based Burnout Velocity Space



SYSTEM EVOLUTION PLAN (SEP)

Pre-Decisional / Working Papers

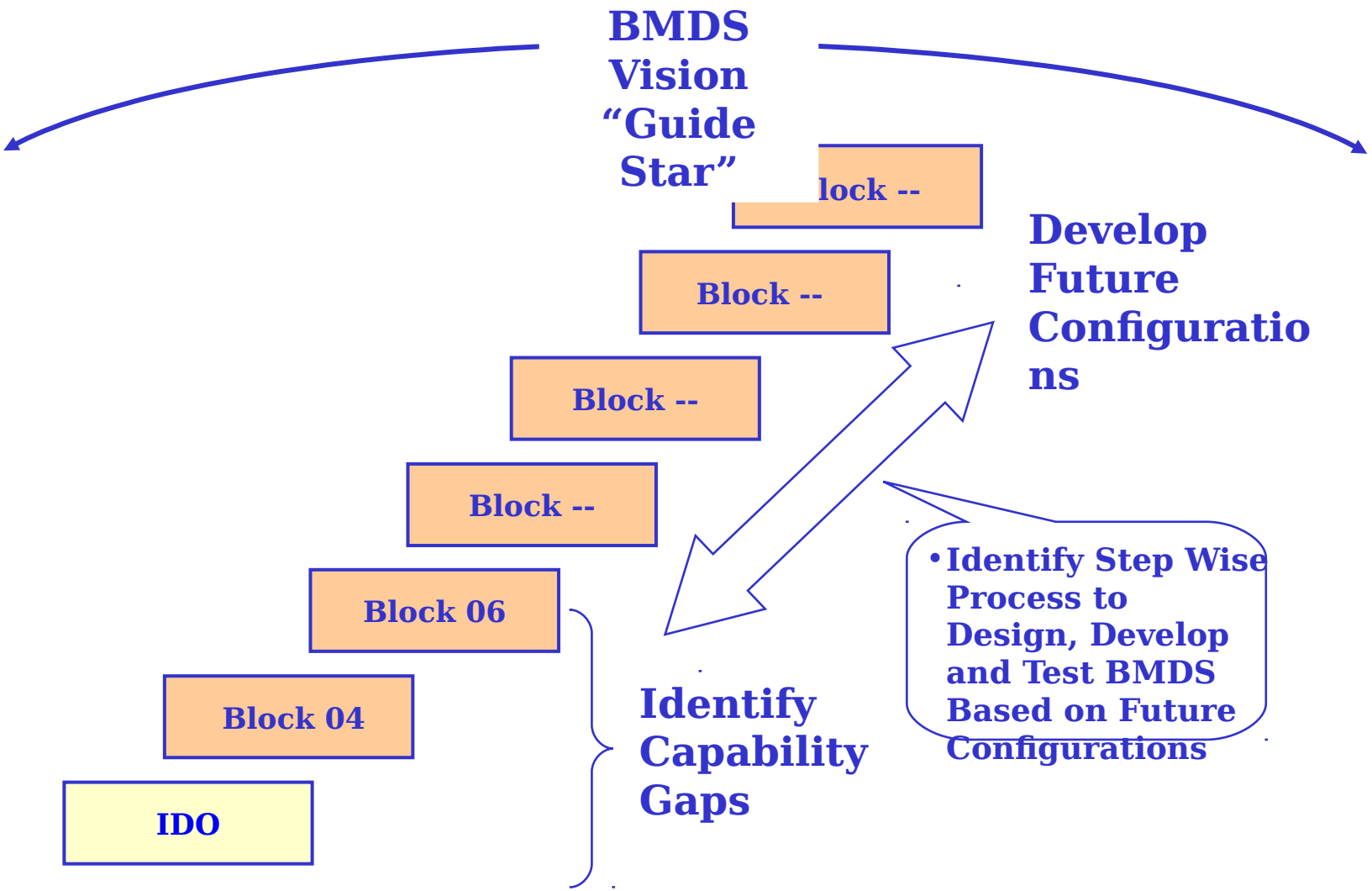
- **SecDef Guidance, Director's Intent, and Guide Star Provide Initial and End State Vision for the BMDS**
  - **Near Term – Defensive Presence in All Missions, All Phases of Flight**
  - **Far Term – Robust, Complementary Defenses for All Missions, All Ranges, All Engagement Phases Despite Countermeasures**
- **The Long-Term Vision, Translated into Qualitative and Quantitative Terms, Drives the Top-Down BMDS Evolution Plan – the SEP**



The SEP will Explore Alternative Paths / Strategies to Achieve TOG Compliance

BLOCK DEVELOPMENT PROCESS

Pre-Decisional / Working Papers

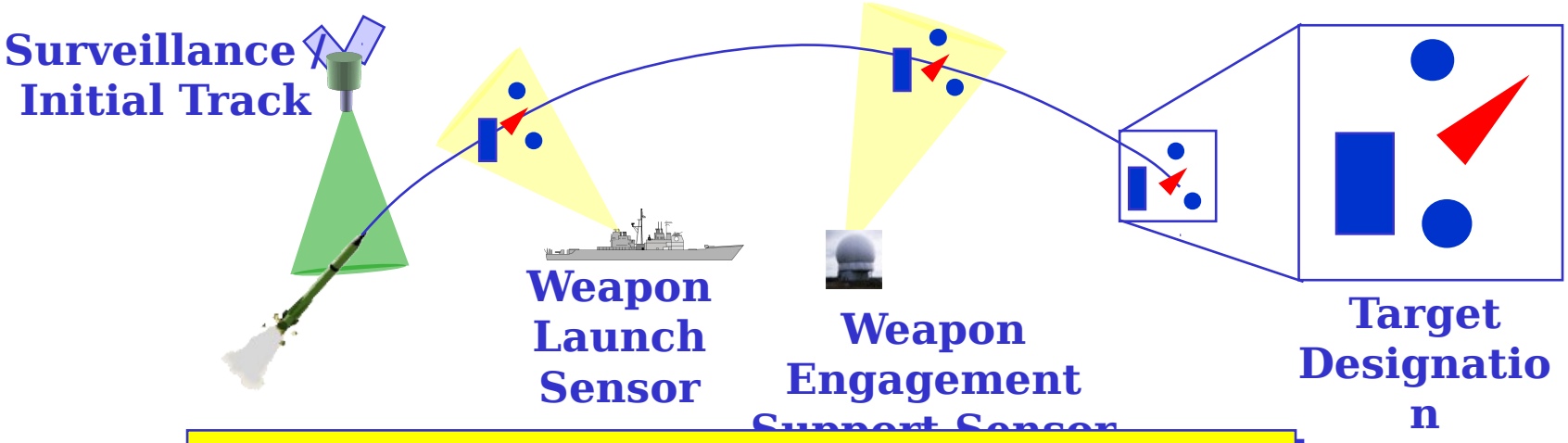


ENGAGEMENT SEQUENCE GROUPS

Pre-Decisional / Working Papers

- **Engagement Sequences Occur when BMDS Components are Employed to Perform Detect-Control-Engage Functions**

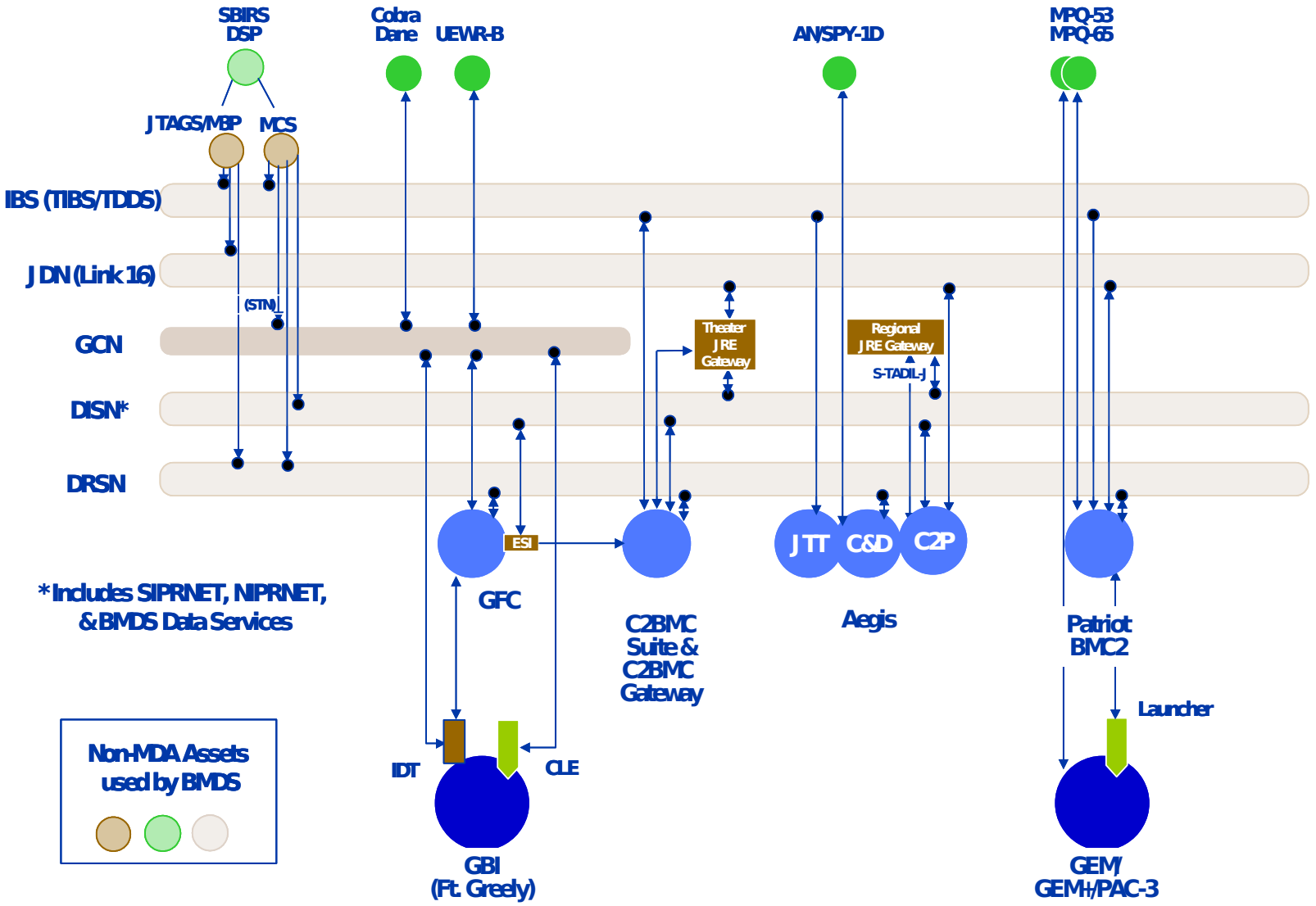
- **All Engagement Sequence Groups Consist of**
  - **Sensor for Surveillance / Initial Detection and Tracking**
  - **Sensor for Weapon Launch**
  - **Sensor or Source for Engagement Support**
  - **Target Designation / Selection**
  - **Launcher / Missile or Directed Energy Weapon**



Engagement Sequences Enabled by Command and Control, Battle Management, and Fire Control Functions

IDC BMDS BLOCK DIAGRAM

Pre-Decisional / Working Papers



BMDS TECHNOLOGY INSERTION FUELS BLOCK EVOLUTION

Pre-Decisional / Working Papers

2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015

1. Plan
2. Execute
3. Adjust

MDA Corporate Feedback

Evolutionary Spiral Development

Block 2004

Block 2006

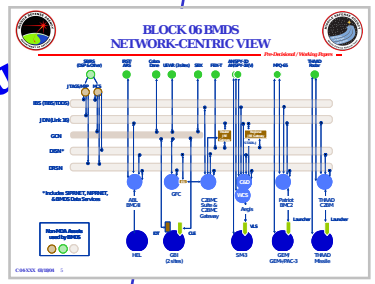
Block 2008

Block 2010

Block 2012

Block 2014

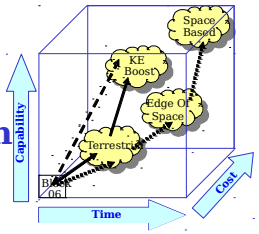
Block n Pull and Technology Pu



Technology Insertion

Sensor and Discrimination Algorithms
Advanced Concept Technology Demonstrations
Decision Architecture Upgrades
"Next Generation" Radars
Kill Vehicle and Seeker Improvements

System Evolution Plan



SYSTEM ENGINEERING & INTEGRATION
MISSILE DEFENSE NATIONAL TEAM

Pre-Decisional / Working Papers

Top Priorities

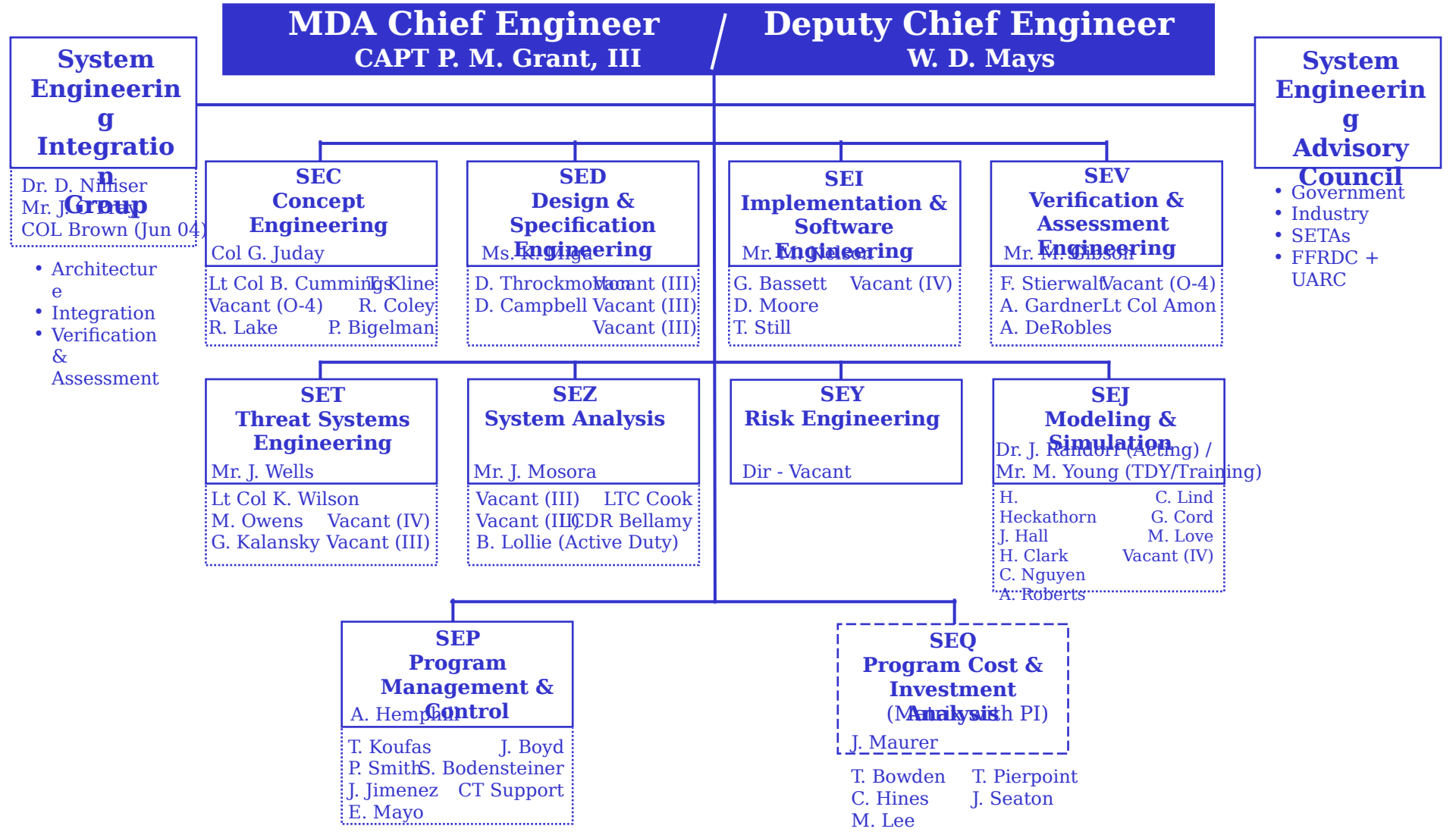
- **IDO BMDS on Alert**
  - BMDS Design
  - IDO Capability Verification
- **Define BMDS Blocks 08 /10**
  - Perform Concept Studies
  - PEER Review Process
  - Baseline Blocks
- **Design BMDS Block 06**
  - Achieve a Quantum Jump in BMDS Integration
  - Begin Evolution Away from Purely Autonomous Systems

Performing a Function Not Possible with Any of the Elements Acting Alone

BACKUP

SE&I GOVERNMENT ORGANIZATION
- ACQ DEMO -

Pre-Decisional / Working Papers



MDNTS FUNCTIONAL WORKING GROUP CHARTER

Pre-Decisional / Working Papers

NTC Concept Engineering

- System Evolution Engineering and International Programs
- TOG – Development & Maintenance
- SEP – Development & Maintenance
- Develops the Proposed Architecture / Block Structures
- CM/CCM (Rainbow)
  - Blue Team
- Technology Requirements

NTD Design & Specification Engineering

- Performs the Detailed BMDS Engineering, Given an Architecture Construct
- Performs Engineering Necessary to Establish and Document the BMDS Specifications
- Standards
- Specialty Engineering
- Information Assurance Design

NTI Implementation & Software Engineering

- Performs Detailed Engineering to Implement the Design
- Software Engineering
- Performs Configuration Management for BMDS
- Performs Risk Mitigation Activities
- Configuration Change Board (CCB)
- Monitors TPMs

NTV Verification & Assessment Engineering

- All Verification and Assessment Activities
- Verification of Compliance with Mandated Processes
- Assessment Activities Include the "As-Built" Assessments to Determine the Actual Capability
- Verification Activities are Focused to Ensure the System Works as Specified
- Define TPMs
- Develop Test Objectives
- Develop Target Requirements
- Command & Control Wargames

NTT Threat Systems Engineering

- ACD/AVD
- Corporate Lethality Program
- Threat – Threat Risk Assessments
- Lethality – Interface with IN and the Special Programs Center
- CM/CCM
  - Black Team

NTZ System Analysis

- Conducts All of the Analysis to Support SE Efforts
- Specific Sub-Groups will be Formed to Support Various SE Functions
- A Single Analysis Team Ensures Consistency of Analysis

NTY Risk Engineering

- Executes the Entire Risk Process Across the MDNTS Enterprise
- Includes Identification, Assessment, Handling and Monitoring
- Supports the Range of Risk Management from Supporting Gap Analysis of Architecture to Detailed Assessments of the Block Being

NTJ Modeling & Simulation Engineering

- Development & Maintenance of the Core Models
- Development & Maintenance of the "Virtual Model"
- Includes Associated Facilities Such as ARC/SIM Center and Interface to JNIC System Level Simulations (e.g. HWIL)

NTO Program Cost and Investment Analysis

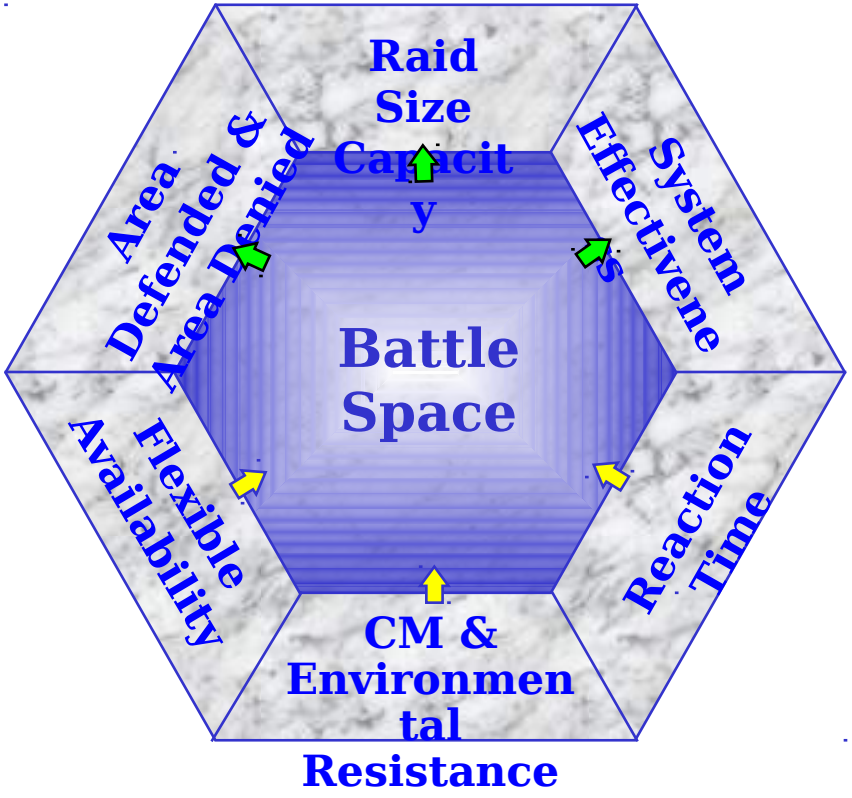
- Perform Costing of the MDA BMDS
- Perform Investment Analysis in the System Evolution Process

NTP Program Management & Control

- Management Operations
- Program Support to SE
- Graphics
- Business Management
- Information Tech
- Security
- Facilities
- Program Coordination

BMDS CORNERSTONES

Pre-Decisional / Working Papers



- **BMDS Cornerstones Satisfy Presidential Directive**
  - All Phases, All Ranges, All Regions
- **Cornerstones Define Technical Objectives and Goals Effectiveness Metrics**
- **Element Effectiveness Metrics Traceable to BMDS Cornerstones**
- **Cornerstones will Evolve**
  - Consequence of Capability-Based Acquisition

Cornerstones Describe Technical Objectives and Goals

DESIGN & SPECIFICATION ENGINEERING

Pre-Decisional / Working Papers

Input

Concept Engineering

Block Design Data Package

- **Toolbox**
- **Architecture**
- **Analysis**

Design & Specification

- **Capabilities Engineering**
- **Performance Trade Studies**
- **System Sub-System Performance**
- **Interface Engineering**
- **Standards & Specialty Engineering**

System Synthesis

Design Products

- **SCS**
- **ICS**
- **ACN's**
- **Standards**

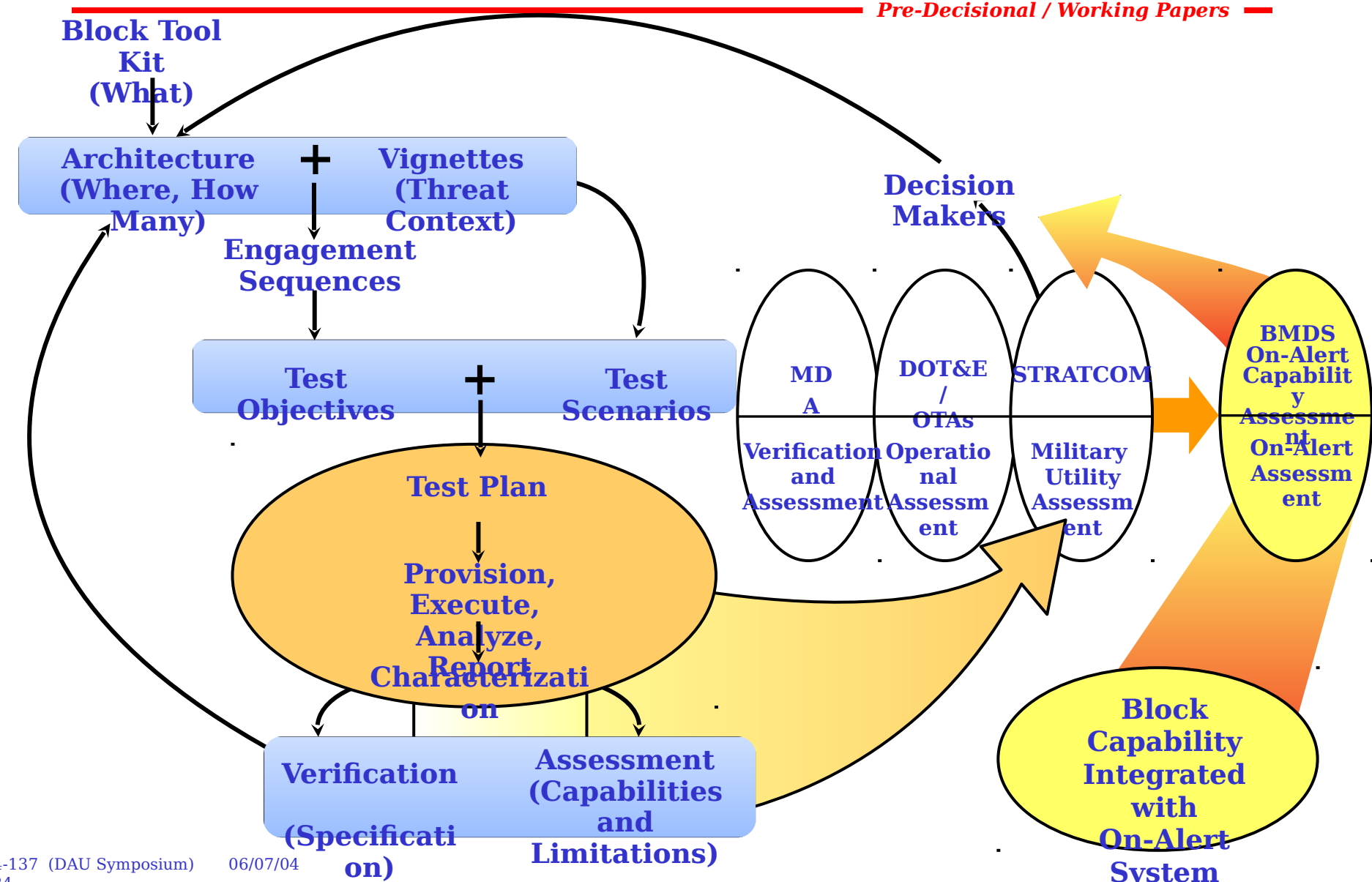
Corporate Databases

- **DOORS**
- **System Architect**
- **Engineering Notebook**

Proposed

BMDS TEST AND ASSESSMENT

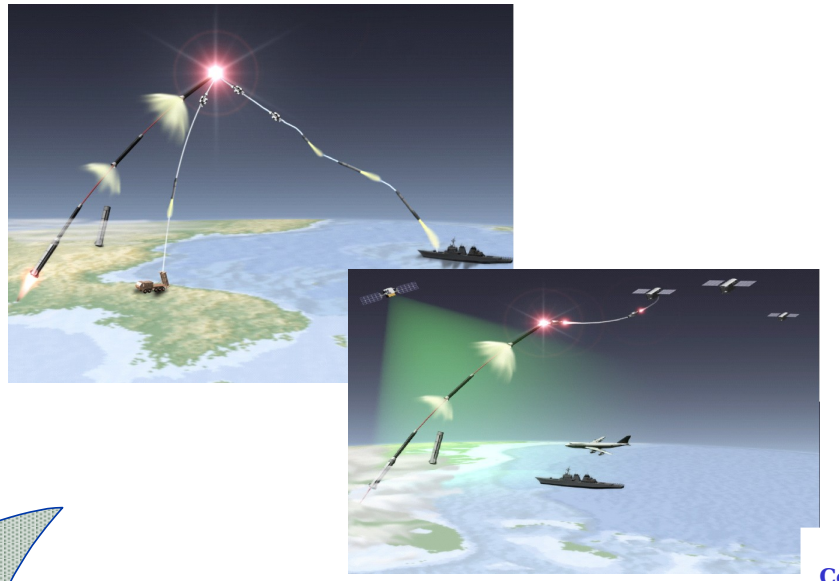
Pre-Decisional / Working Papers



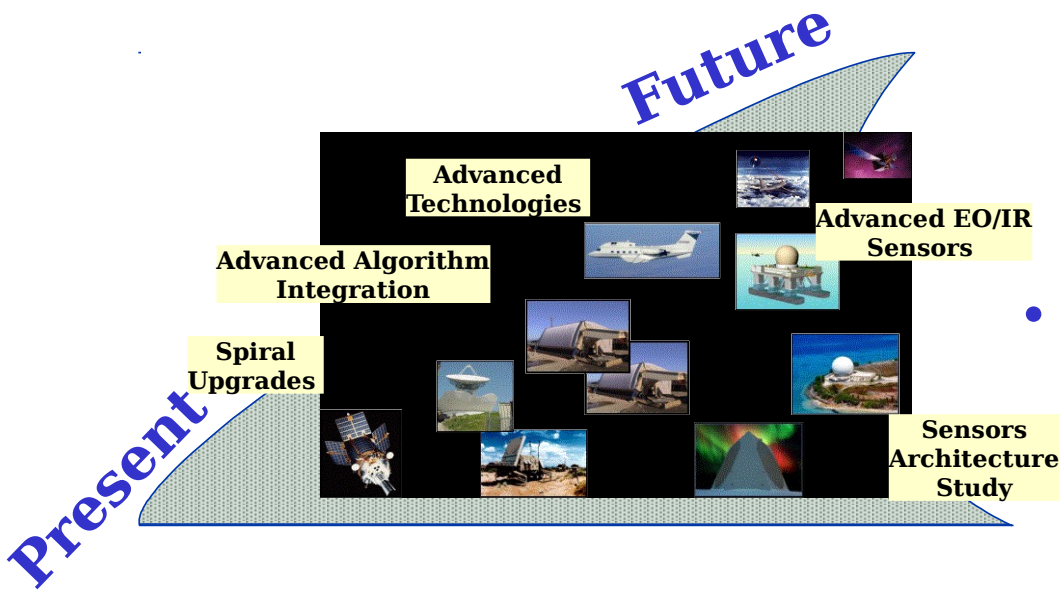
MDA DIRECTORATE COLLABORATION

Pre-Decisional / Working Papers

- **Support to Kinetic Interceptor Directorate / Boost Phase Procurement**



Overlay Comparison



- **Formation of BMDS Netted Sensors Directorate (MDA / SN)**

SYSTEM ENGINEERING CYCLE TIME REDUCTION

Pre-Decisional / Working Papers

Block 04 Definition & Design Cycle

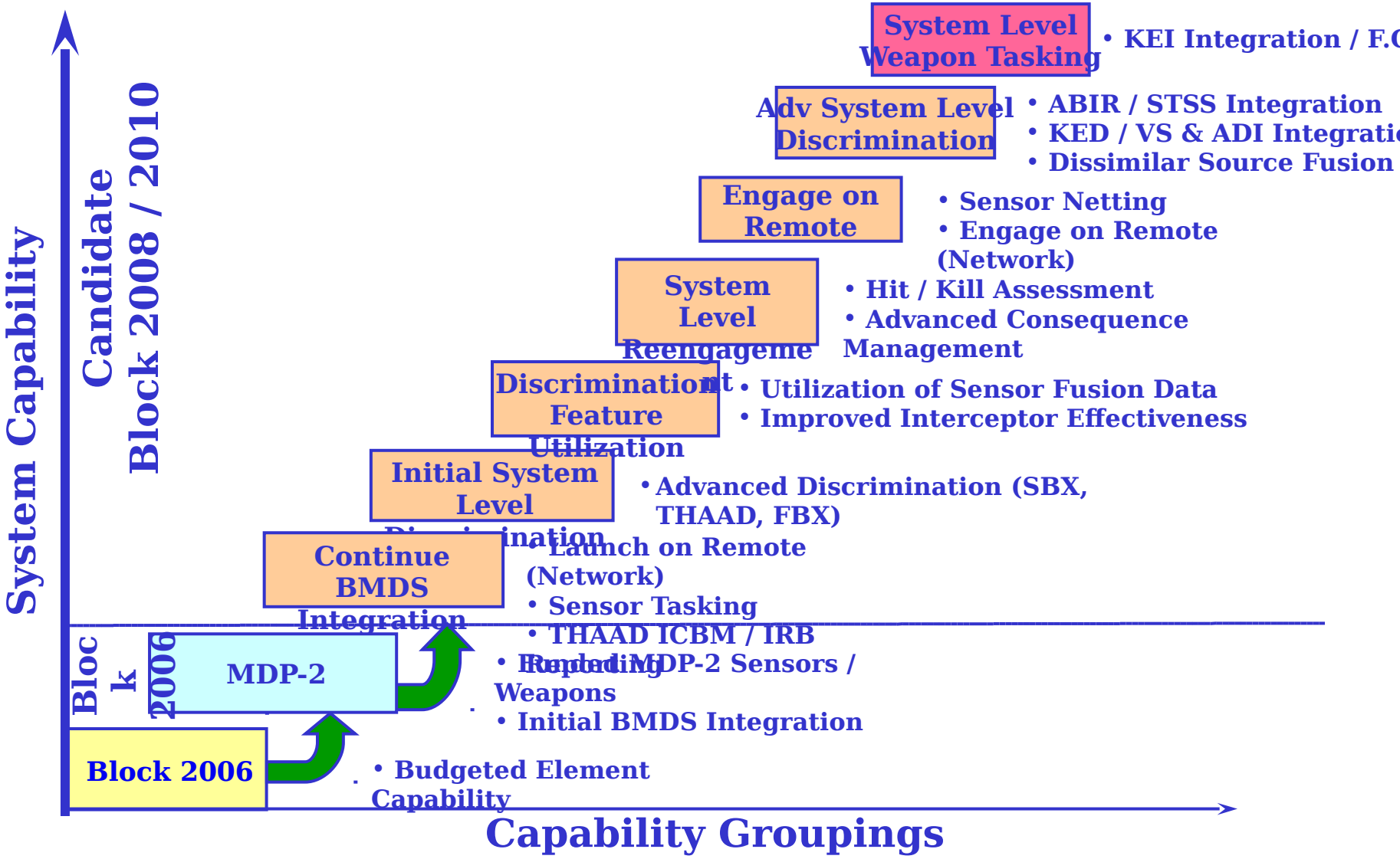
Block 06 Definition & Design Cycle

Block 08 Projected Definition & Design Cycle

Increasing System Performance Through Assessment of Multiple System, Component and Interface Options

PRIORITIZED BLOCK CAPABILITY PROGRESSION

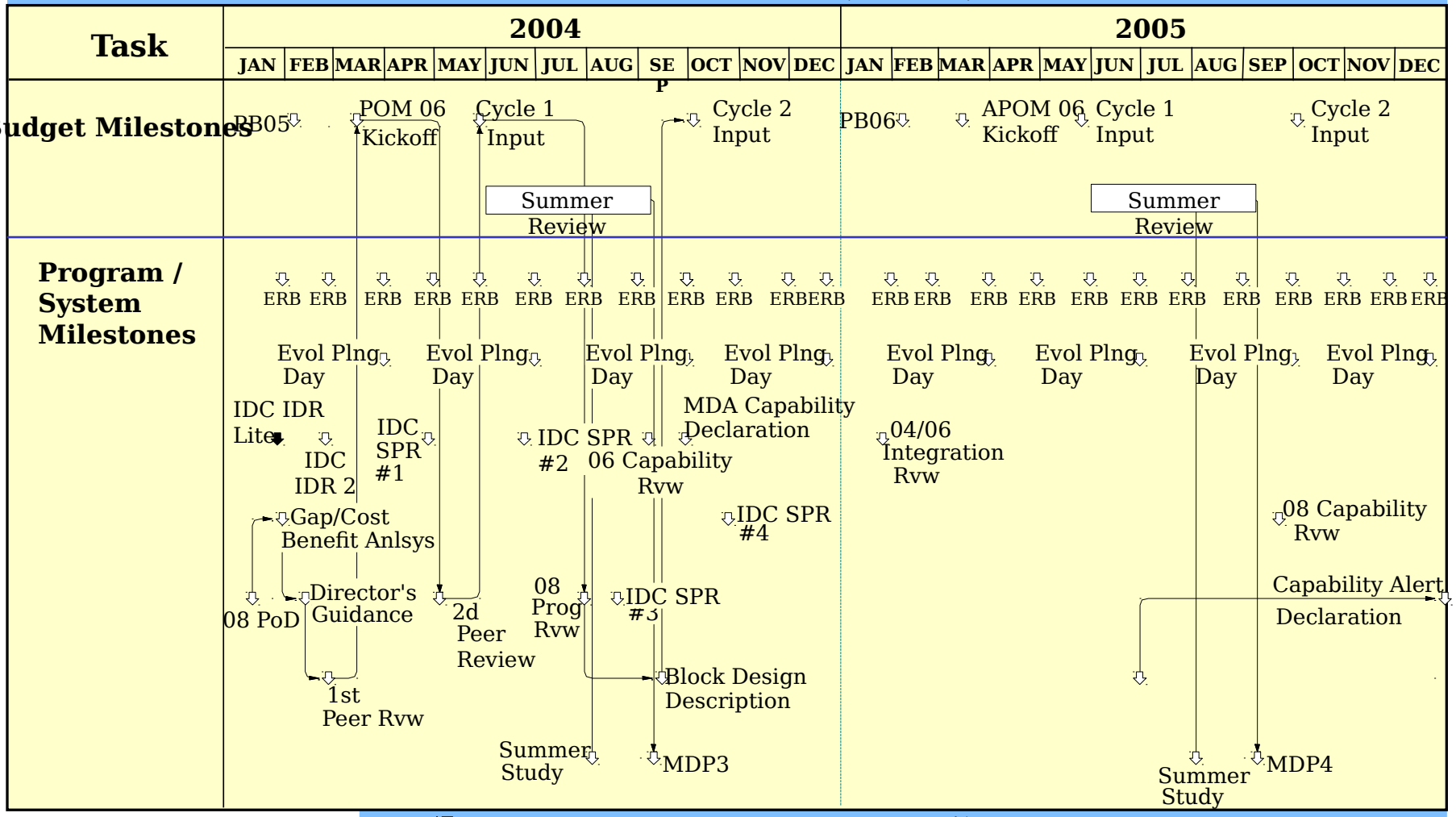
Pre-Decisional / Working Papers


System Capability
Candidate Block 2008 / 2010
System Level Weapon Tasking
• KEI Integration / F.C
Adv System Level Discrimination
• ABIR / STSS Integration
• KED / VS & ADI Integrati
• Dissimilar Source Fusion
Engage on Remote
• Sensor Netting
• Engage on Remote (Network)
System Level Reengageme
• Hit / Kill Assessment
• Advanced Consequence Management
Discriminatio nt Feature Utilization
• Utilization of Sensor Fusion Data
• Improved Interceptor Effectiveness
Initial System Level Discrimination
• Advanced Discrimination (SBX, THAAD, FBX)
Continue BMDS Integration
• Launch on Remote (Network)
• Sensor Tasking
• THAAD ICBM / IRB
• Expanded MDP-2 Sensors / Weapons
• Initial BMDS Integration
Block 2006
MDP-2
Block 2006
• Budgeted Element Capability
Capability Groupings

SYSTEMS ENGINEERING DEVELOPMENT CYCLE SYNCHRONIZED TO BUDGET

Pre-Decisional / Working Papers

MDNTS Schedule (Tier 1)



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BMDS PERFORMANCE CORNERSTONES

Pre-Decisional / Working Papers

- **Reaction Time**
- **Launch Area Denied / Area Defended**
- **Flexible Availability**
- **Countermeasures and Environmental Resistance**
- **Raid Size Capacity**
- **BMDS Effectiveness**

MISSILE DEFENSE AGENCY
DEPARTMENT OF DEFENSE

MISSILE DEFENSE AGENCY
All Phases
All Ranges
All Regions
Missile Defense National Team